

Minutes on SNS wire scanner discussion meeting

Date: August 23, 2000

Place: Monterey, CA

Subject: SNS wire scanner plan

Attendee: S. Aleksandrov, L. Allen, L. Doolittle, D. Douglas, H. Edwards, W. Funk, J. Galambos, R. Hardekorf, L. Harwood, Z. Igarashi, R. Kustom, E. McCrory, M. Popovic, D. Raparia, A. Ratti, C.H. Rode, J. Santucci, C. Schmidt, R. Shafer, T. Shea, J. Stovall, R. Sundelin, R. Webber, J. Wei, M. White

Summary:

The issue is on the necessity and potential risk of having wire scanners in the superconducting RF linac Section of the SNS.

Wire scanners are necessary for SNS SCL for the following reasons:

- 1) for the purpose of transverse emittance monitoring, core and tail/halo profile measurement, and eventual diagnostics on mis-matching breathing (warm-cold, SC1 to SC2), cavity failure, and system malfunction
- 2) based on LANSCE experience, tuning with loss monitors is painful and inefficient even in the commissioning mode of 33 kW beam power.
- 3) the design loss level is 1 Watt per meter beam power. At a full 2 MW beam power, the allowed beam loss is $1e-6$ per meter. Furthermore, the collimator at the end of the linac is designed to take $1e-3$ of total 2 MW beam (90% efficiency, residual activation control) -- a condition much stringent than any existing linac.
- 4) three-bump aperture scan will be used, but does not carry enough information to identify the error source; "Witkover/Fechinco" longitudinal profile monitoring can be implemented but refitting transverse information with adequate accuracy is not practical.
- 5) Alternatives are not mature – these include (a) laser scanner, which is under test at BNL AGS Linac (POP experiment) but premature to be considered as baseline design; (b) flag, but heating problem is more pronounced (c) fluorescent gas, but vacuum is a problem (d) flying wire, which causes large motion although can handle full beam pulse

Potential risk exists due to the following reasons:

- 1) wire heating caused by H- beam is more pronounced due to additional two electrons
- 2) based on Jlab experience, (Q decreased from $1e9$ to $1e6$ after a 6-month run) dust can be a problem; charged and carried to cavity from warm section escaping pumping. The cause (e.g. ferrite shutters) is not wire scanner but DUST set to MOTION is the key ingredient, and electrostatic precipitator is used.
- 3) fast gate valve operation, flange removal (in clean tent) can cause similar problem is care is not taken.
- 4) scanner sandwiched by precipitators (two) is not practical due to space/cost.
- 5) solid metal is preferred; graphite or carbon wire has erosion/vacuum problem.

Wire scanner is plausible due to the fact:

- 1) TTF actually uses wire scanners, although the configuration needs to be found out (contact Padro Custro and Hans Weise of DESY, suggested by H. Edwards)
- 2) Wire scanner is used in copper linac like LAMPF linac
- 3) hydroform articulator bellows can be used (rocking side-to-side), only tempered folk is above midplane
- 4) entire system should/can be done with minimum dust, as done with Jlab FEL
- 5) wire can be high-pressure rinsed; designed with care (e.g. no rubbing surfaces)
- 6) wire scanners, if not used, causes not problem; but having them can be flexible
- 7) machine protection, at the same level as personnel protection, should/can be adopted to prevent fault event

Conclusions:

- 1) stepping wire scanners are needed in SCL
- 2) the design needs to be minimum dust and with extra care

Action items:

- 1) evaluate the reasonably minimum number of wire scanner needed (Stovall, Raparia, Galambos)
- 2) contact TTF for the optimal design; adopt hydroform bellows (Stovall, Shea)
- 3) machine protection required (Dodson, Gurd, Shea)